The Rise of Chinese Exports[$]

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Abstract

The growth of Chinese exports both in volume and in market share over the past two decades is a singular event in the history of world trade. Using data from 1995-2005, we document this growth in a variety of ways. First, we show that the expanded trade is pervasive. Virtually every country in the world has seen China claim a larger share of its import market. Then, we use Constant Market Share (CMS) analysis to try to determine which country or countries have lost market share as China's trade has grown. Contrary to much discussion in the popular press, we find strong evidence that other developing countries have not seen export shares fall as a result of China's gains. Rather, our results suggest that China's share growth has come largely at the expense of exporters based in Japan and the United States. We then turn to an attempt to identify the factor or factors responsible for export growth. Using a large set of data disaggregated at the 5-digit SITC level on trade among 75 countries we look at changes over the period in import unit values. We find that China has maintained a relatively constant price advantage over U.S. and Japanese exports. In addition, we use 3-digit level data to estimate a heterogeneous-firm model that examines the probability of successful entry by a firm into an export market. We find strong evidence that the growth of Chinese exports is due to entry by new firms within any sectors, probably engendered by firm level technological advance or entry of foreign firms that have begun to produce in and export from China.

1. Introduction

Over the past two decades the Chinese economy has grown at a remarkable pace. According to the Penn World Tables, between 1995 and 2007 Chinese real GDP grew at an average annual rate of more than 10%. Per capita real GDP rose by 250% over this period.[1] One of the leading factors driving this economic growth has been the extraordinary performance of Chinese exports. According to the World Trade Organization (WTO), in 2008 China ranked second in exports to the world market with merchandise export sales of $1.4 trillion and a world market share of 8.9%. In 1998, China had less than 2% of the world market. Twenty years earlier, China's share was essentially zero. As China's share of world exports has grown, it has come under increasing pressure to allow its currency to appreciate; often the criticism of its exchange rate practices includes charges that other developing and emerging market economies have borne the brunt in terms of lost export markets.[2]

The purpose of this paper is to provide an analysis of Chinese export growth over the period when its share of world exports rose most rapidly, the years 1995-2005. We provide detail on the commodity composition of Chinese exports and how this composition has changed. We also discuss some aspects of the geographic pattern of Chinese trade. In addition, a fundamental contribution of this paper is that we provide considerable evidence that the principal exporting countries that have lost market share to China are Japan and the United States.

[1] These numbers use China Version 2 data from the PWT6.3 data set. See "What is New in PWT 6.3?" link on the Penn World Tables site, http://pwt.econ.upenn.edu/php_site/pwt_index.php, for a discussion of the differences between this version of Chinese data and official Chinese data.

[2] See, for instance, Arvin Subramanian, "Who Pays for the Weak Renminbi?", 11 February 2010, *Vox Front Page*, http://www.voxeu.org/index.php?q=node/4604.

We then turn to a discussion of what factors have been most important in explaining Chinese export growth. We show that export price advantages are an important part of the story, and provide evidence that these advantages cover a broad range of differentiated products. We then expand and estimate a model of the firm level decision to export first developed by Helpman, Melitz, and Rubinstein (2008). Our paper represents one of the first attempts to apply and estimate this model using product level data.[3] We find strong evidence that Chinese export expansion over this period is due to the entry of new firms probably engendered by firm level technological advance and/or the entry of foreign firms that have begun to produce in and export from China.

The rest of the paper proceeds as follows. In section 2 we present an overview of Chinese trade expansion. In section 3 we discuss Constant Market Share (CMS) analysis, an empirical technique that provides a method for studying changes in export market shares. In section 4, we apply CMS to study trade patterns among a sample of 75 countries over the period 1995-2005 in commodity trade disaggregated at the 5-digit SITC level. In section 5, we expand our analysis by focusing on export behavior across industries and in individual export markets. In section 6 we report estimates of import unit values as well as estimates from our expanded version of the Helpman-Melitz-Rubinstein model. Section 7 offers our conclusions.

2. An Overview of Chinese Export Performance

Figure 1 provides a time series plot of world export shares for five of the world's leading exporting countries, Germany, China, Japan, the United Kingdom, and the United States. As the figure shows, since the end of World War II, only Germany has seen as

[3] Manova (2010) is another study that uses disaggregated data in the context of this model.

rapid and as large a rise in world export share as China. In the eleven year span from 1948 to 1958, Germany's share of world exports rose from 1.3% to 10.3%, roughly matching in both magnitude and duration China's performance. However there are several major differences between the two. First, Germany's growth almost certainly represented a return for that country to a market position similar to the one that it had held prior to the war era. Second, at the time of Germany's significant growth there were far fewer major exporters competing for market share. For instance, at the time of Germany's growth the combined world export share of the countries now known as the Asian NICs (Korea, Malaysia, Singapore, and Thailand) was virtually zero. In contrast, since at least the onset of the industrial revolution and prior to the 1990s, China had never held a significant share of world trade. And, China's export growth came only slightly after significant growth by the NICs and simultaneously with major growth by several other countries that along with China make up the BRICs (Brazil, Russia, and India), all of whom now also hold large shares of the world market.

[Insert Figure 1 about here]

Like all major exporting countries, China has a market presence in virtually every country in the world; this presence has grown in almost every market in recent years. Using data from the IMF's *Direction of Trade Statistics* we calculated aggregate exporter market shares in 80 countries and 1 territory (Hong Kong), from all parts of the world.[4] Several interesting patterns emerge from this exercise. First, the global extent of China's trade expanded significantly between 1995 and 2005. By 2005, China had at least 2% of

[4] These countries were chosen from those studied in Cassing and Husted (2004). See their Table 6A.1. Ten countries, all from low income countries from Asia and Africa, were excluded due to lack of data. Complete results provided on request.

the market in all but three of these countries.[5] Moreover, market share growth was pervasive; over the 1995-2005 period China's market share grew in all of these markets except one.[6] In many cases, especially in South America, Africa, and smaller European countries, shares were essentially zero prior to 1995. Table 1 provides some additional summary statistics.

[Insert Table 1 about here]

According to the table, geography is clearly important for China's trade. Its highest shares are in Asia where among the sample countries it had an average share of 12.8%. Its highest market share among all the Asian countries in the sample stood at 45%.[7] Its next highest average regional market share was in North America; this included 13% of all U.S. merchandise imports in 2005. On average, China's smallest regional market penetration was in Europe, where its average national market share in 2005 was only 4.1%.

As China's export market share has grown in recent years, it has changed the mix of goods it supplies to these markets. In order to illustrate this change in the commodity composition of trade, we restrict our attention to exports of differentiated manufactured products disaggregated at the 5-digit SITC level.[8] Due to missing data for several African countries, in much of what follows we analyze data from a subset of seventy five

[5] The exceptions are Burkina Faso (1.6%), Portugal (1.2%), and Switzerland (1.4%).

[6] The country where China's export share fell was Malawi. This fall was due in part to an abnormally high (for the time) level of China's exports to Malawi in 1995.

[7] This was China's share of Hong Kong's market. Among the other Asian countries in this sample China had more than 20 % of Japan's market in 2005 and more than 10% of the export markets of Bangladesh, Korea, Pakistan, Singapore, and Sri Lanka.

[8] With one minor exception, the data we use are imports and are taken from the United Nations Commodity Trade Statistics Database (UN Comtrade).

countries.[9] Our sample includes countries from every continent and includes countries at various standards of living; slightly more than one-third the countries chosen in our sample are classified by the World Bank as high income countries. In 2005, the countries used in our analysis accounted for 87% of total world imports. Trade among these countries accounted for a majority of all world merchandise trade in each of the two years in our sample.

[Insert Table 2 about here]

Table 2 provides detail on the composition of Chinese exports in 1995 and 2005 to our sample of markets as well as the countries identified as developing countries across broad categories of goods.[10] Also included in the table is China's portion of total world exports at the 1-digit level (SITC Rev.3) in 1995 and 2005. As the table shows, Chinese exports have been centered in manufactures for some time. In 1995, 86% of Chinese exports to our sample countries came from industries 5-9. By 2005, that share had risen to almost 94% of total exports. Traditionally, Chinese exports have been concentrated in Miscellaneous Manufactured Articles (Industry 8). This sector includes many labor intensive manufactured products such as clothing, footwear, and toys, items long identified as characteristic examples of Chinese exports. Twenty five percent of Chinese

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[9] In addition to China, we use the following countries: (Africa) Algeria, Burundi, Burkina Faso, Cameroon, Central African Republic, Benin, Gabon, Gambia, Ghana, Côte d'Ivoire, Kenya, Malawi, Mali, Mauritius, Morocco, Niger, Senegal, Tunisia, Uganda, and Tanzania; (Asia and Pacific) Australia, Bangladesh, Hong Kong, Indonesia, Japan, South Korea, Malaysia, New Zealand, Pakistan, Philippines, India, Singapore, and Thailand; (Europe) Austria, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom; (Middle East) Israel, Jordan, Oman, Qatar, Saudi Arabia, and Turkey; (North America) Canada, Mexico, and USA; (Central & South America) Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Guatemala, Guyana, Honduras, Jamaica, Paraguay, Peru, Suriname, Uruguay, and Venezuela. All of these countries were included in the 81 countries that make up the sample for Table 1. The six countries that we were forced to drop from the sample are Brunei, Fiji, Guinea-Bissau, Haiti, Nigeria, Sri Lanka and the United Arab Emirates. Since import data for 1995 are not available for six countries, we use the closest years from 1995: Benin (1998), Gabon (1996), Ghana (1996), Mali (1996), Senegal (1996), and Guyana (1997).

[10] Developing countries are those not classified as being a High Income Country by the World Bank in its 2009 *World Development Report*.

exports to our sample countries in 2005 came from this sector. However, this share had stood at 37% of total exports to these markets in 1995. Instead, in recent years, the share of Chinese exports of more sophisticated manufactures has risen substantially with exports in Machinery and Transport Equipment (Industry 7) more than doubling to almost 48% of its exports to the sample markets and 52% of its sales to the developing country markets in the sample in 2005.

China's world market shares changes over this period followed the transformation described above. Between 1995 and 2005, its share of Industry 7 exports to the world increased by a factor of four, while its Industry 8 market share increased by ten percentage points. We are not the first to point out the recent growth in the sophistication of Chinese exports. Rodrik (2006) calculates that by 2002 China had an export bundle "of a country with an income per-capita level three times higher than China's".[11] In a related study, Schott (2008) focuses on Chinese exports to the United States. He finds that the composition of this export bundle "increasingly overlaps with that of the world's most developed economies".[12]

The data in Tables 1 and 2 document the growth of Chinese exports and the change in the sectoral composition of these goods over the period 1995-2005. Clearly, the rapid growth of China in the world market has had market share implications for other exporting nations. A number of papers have focused on various aspects of the recent growth of Chinese exports on global competition.

One focus of attention has been on whether the growth has occurred due to an expansion of the variety of goods exported (the extensive margin) or a growth in trade of

[11] Rodrik (2006) pg. 4.
[12] Schott (2008) pg. 34.

existing varieties (intensive margin). Broda and Weinstein (2006) find that over the last quarter of the twentieth century roughly 30% of U.S. import growth was at the extensive margin, with China the largest contributor. However, using Chinese export data disaggregated at the HS-8 level, Amiti and Freund (2010) report that most of Chinese export growth to the world between 1997 and 2005 was in existing varieties. Most recently, Manova and Zhang (2009) using firm level data on Chinese trading firms find that a relatively few large firms are responsible for substantial share of exports; these firms export to many markets, and many are foreign owned.

One focus of our paper is on which other exporting countries are losing foreign markets due to the rise of China. Other papers have also attempted to address this question. Using a gravity model, Hanson and Robertson (2010) study ten developing countries they identify as potential losers to Chinese competition. However, they find Chinese export expansion over the 1995-2005 period has had only a modest negative impact on the exports of these other countries. In an earlier study, Ahearne et al (2003) use VAR analysis to see if Chinese exports reduce the exports of other Asian economies. They find instead a positive correlation between exports from these two sources. These findings along with the industry classifications of Chinese exports suggest that major competing countries with China in world export markets may be developed rather than developing countries. In the remainder of this paper, we try to identify which countries have lost share and to provide a measure of the size of the losses. We also focus on the growth of Chinese exports at broad industry levels and in individual export markets. We turn now to describe the modeling strategy we employ to answer these questions.

3. Market Shares Methodology

Constant Market Share (CMS) analysis has long been used to study export performance.[13] This modeling approach treats as a norm of behavior that a country's market share will remain constant over time. If instead it changes, that must be due to changes in competitiveness or changes in demand from the world as a whole or in individual markets. The analysis then proceeds to decompose export share changes in order to identify these factors. In the 1950s and 1960s, CMS was a popular tool of analysis. In a well known paper, however, Richardson (1971) criticized its use, arguing that the signs and magnitudes of the measured effects depend upon in part on the methods used in their calculation.

Taking these criticisms into account, Fagerberg and Sollie (1987) (hereafter FS) have proposed several refinements to traditional CMS analysis. These include improved theoretical consistency via the use of Laspeyres weights throughout and an explicit economic interpretation of all decomposed terms. They have also extended the traditional model to include two additional terms which measure the adaptability of the export sector of a country to changes in the commodity and national market composition of world exports.[14] We now turn to a brief derivation of their model.

First, consider the change in exporters' shares in each importer's market. We define the value of imports of product *i* from country *k* to *l* is defined as m_i^{kl}. The market share of country *k* (an exporter) in product *i* in market *l* (an importer) is

$$a_i^{kl} = m_i^{kl} / \sum_k m_i^{kl} \, . \tag{1}$$

[13] See Leamer and Stern (1970) Chapter 7 for a derivation of the original model and the references therein for examples of its use.

[14] Irwin (1995) uses the FS approach to study changes in the export market share of Great Britain in the early 20th century.

Product i's share of country l's total imports is defined as

(2) $$b_i^l = \sum_k m_i^{kl} / \sum_i \sum_k m_i^{kl} .$$

Since the market share of country k is written as

$$M^{kl} = \sum_i a_i^{kl} b_i^l ,$$

the change in country k's share of market l between an initial year (time 0) and year t is

$$\Delta M^{kl} = M_t^{kl} - M_0^{kl} .$$

This equation can be rewritten as the sum of three terms:

(3) $$\Delta M^{kl} = \Delta M_a^{kl} + \Delta M_b^{kl} + \Delta M_{ab}^{kl} .$$

where

(4) $$\Delta M_a^{kl} = \sum_i (a_{it}^{kl} - a_{i0}^{kl}) b_{i0}^l$$

(5) $$\Delta M_b^{kl} = \sum_i a_{i0}^{kl} (b_{it}^l - b_{i0}^l)$$

(6) $$\Delta M_{ab}^{kl} = \sum_i (a_{it}^{kl} - a_{i0}^{kl})(b_{it}^l - b_{i0}^l)$$

Equation (4) is the effect of changes in the market share, weighting the change in exporter k's share of product i exports by the initial share of the product in market l. Equation (5) is the effect of changes in the product composition of importer l, weighted by the initial share of the product from country k. The final term, equation (6), is a residual term which can be written as

(7) $$\Delta M_{ab}^{kl} = r_{ab}^{kl} \left[\sum_i (a_{it}^{kl} - \bar{a}_t^{kl} - a_{i0}^{kl} + \bar{a}_0^{kl})^2 \right]^{0.5} \left[\sum_i (b_{it}^l - b_{i0}^l)^2 \right]^{0.5}$$

where r_{ab}^{kl} is the correlation coefficient between the changes in market shares and the changes in product shares.

FS then extend the decomposition exercise from one market to the world market. The country l's share of world imports is defined as:

(8) $$c^l = \sum_k \sum_i m_i^{kl} / \sum_k \sum_l \sum_i m_i^{kl}$$

In this case, we can write the market share of county k in world market as

$$M^k = \sum_l M^{kl} c^l \ .$$

The change in M^k between time 0 and time t is

$$\begin{aligned} \Delta M^k &= \Delta M_m^k + \Delta M_c^k + \Delta M_{mc}^k \\ &= \Delta M_a^k + \Delta M_b^k + \Delta M_{ab}^k + \Delta M_c^k + \Delta M_{mc}^k \end{aligned}$$

where

(9) $$\Delta M_a^k = \sum_l \left[c_0^l \sum_i (a_{it}^{kl} - a_{i0}^{kl}) b_{i0}^l \right]$$

(10) $$\Delta M_b^k = \sum_l \left[c_0^l \sum_i a_{i0}^{kl} (b_{it}^l - b_{i0}^l) \right]$$

(11) $$\Delta M_{ab}^k = \sum_l \left[c_0^l \sum_i (a_{it}^{kl} - a_{i0}^{kl})(b_{it}^l - b_{i0}^l) \right]$$

(12) $$\Delta M_c^k = \sum_l M_0^{kl} (c_t^l - c_0^l)$$

(13) $$\Delta M_{mc}^k = \sum_l (M_t^{kl} - M_0^{kl})(c_t^l - c_0^l)$$

Our analysis focuses on equations (9)-(13); following FS, each can be interpreted as a separate factor that influences export performance.

Equation (9) is the ***market share effect***. This term captures the change in an exporter's share of each product in each country, holding constant the initial commodity composition and the country distribution of world trade. Thus, it captures the extent to which an exporter gains market share independent of changes in the product and destination pattern of world trade. Equation (10) is the ***commodity composition effect***.

The commodity composition effect measures the influence of the changing share of products in world trade on an exporter's overall share. If, for instance, the structure of world imports changes towards more manufactured goods and away from agricultural products, the exporters of manufactured goods (agricultural goods) would see an increase (a decrease) in their market shares.

Equation (11) is the ***commodity adaptation effect***. The commodity adaptation effect identifies whether the change in the structure of a country's exports is correlated with changes in the commodity composition of world imports. This number is zero if the country changes its export structure at the same rate as all countries exporting to the world market. Equation (12) is the ***market composition effect***. This effect measures the influence of changes in the country demand pattern of world imports. Thus, it identifies the countries that increase their world market share by selling their products heavily in expanding markets. Finally, equation (13) is the ***market adaptation effect***. This effect captures the correlation between a country's export destinations and world export destinations.

4. Empirical Results: Aggregate Analysis

For each country in our study, the change in market share of the world market is decomposed into the five effects discussed above. The results for regional exports and a selected set of countries are given in Table 3.[15] The right-most column in table provides the overall percentage change in the total sample export market share for each of the

[15] We concentrate on 2001 5-digit exports of goods that Rauch (1999) and Hallak (2006, 2010) define as differentiated products at the 3-digit level. Most of these products are from 1-digit SITC sectors of 5-8. Since there are gaps in 5-digit sub-products 673 and 676 (some types of iron and steel products), we exclude products from these two sectors.

regions and sample countries over the period 1995-2005.[16] The other five columns represent different effects, corresponding to equations (9) to (13), and add up to the total change.

[Insert Table 3 about here]

The first thing to note about the table is that for most countries in the study, overall export shares hardly changed over the sample period (see the last column). This stability of trade shares is a stylized fact of trade patterns at the bilateral level first pointed out and analyzed by Cassing and Husted (2004 and 2009) in two related studies. The principal exceptions to this pattern of export share stability over the sample period are China (+9.42 percentage points (pp)), European countries (-4.47 pp), Japan (-4.26 pp) and the United States (-3.33 pp). These results clearly imply that the growth in Chinese export market share has come largely at the expense of exporters in developed countries, in particular Japan and the United States, rather than exporters in developing countries. Other principal world exporters did experience somewhat smaller market share losses; each of the other G7 countries in the table saw market shares drop over this period, several by more than one percentage point. We turn now to discuss what factors have contributed to these changes in trade shares.

First, according to the decomposition reported in the table, the market share effect appears to be responsible for most of the changes in export performance by the countries in our sample. During the period from 1995 to 2005, the market share effect was strongly positive for China (+9.56 pp) and strongly negative for Japan (-4.45 pp) and the United States (-3.87 pp). With few exceptions, the commodity composition effect, the market

[16] Values for the countries not listed in Table 3 tended to be very small. They are available on request.

composition effect, the commodity adaptation effect, and the market adaptation effect play only small roles in explaining the changes in world trade shares. This is especially true for China, where each of these other factors appeared to have only small effects on the overall change in market share. The fact that the market share effect played such an important role in China's export share gain is consistent with Amiti and Freund's findings that China's export growth was largely at the intensive margin.[17]

Consistent with the findings of Hanson and Robertson, developing countries such as Brazil, India, Indonesia, Malaysia, and Mexico did not lose their market shares in this period despite China's export growth. Indeed, all saw their shares rise, although by much smaller amounts than China's increase. Again, as was the case with China, Japan, and the United States, the market share effect appears to have been the primary factor responsible for the change in total market share.

Why, in particular, are market share losses to China concentrated in Japan and the United States? One answer may be outsourcing by exporters in these two countries to firms in China. As noted, without identifying the countries involved, Manova and Zhang (2009) report that "Chinese joint ventures and affiliates of foreign multinationals were responsible for fully 75%" of the increase in China's trade flows between 2003 and 2005.[18] We have no way to identify which countries host the parent companies of these firms although there is considerable evidence that Japanese firms may be involved. Tomiura (2008) reports that in recent years China has been the destination country for more than half of all the outsourcing done by Japanese firms.

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[17] We explore this point in depth below.

[18] Manova and Zhang (2009) pg. 2.

Evidence that FDI may be responsible for lost U.S. export share is much less strong. Branstetter and Foley (2007) assert that U.S. FDI in China is only an extremely small portion of total U.S. FDI activity. Moreover, they argue that more than 90% of the production of U.S. affiliates in China is sold in China rather than exported to the United States or other markets. Thus, for the United States, FDI in China is at most only responsible for a share decline in the Chinese market although we have no way to examine outsourcing between unaffiliated firms. Instead, as we show below, a chief factor in explaining export market loss is a significant price advantage of Chinese exports across a large spectrum of products. And, given that we measure import prices in dollars, Chinese exchange rate policy may possibly play a role.

5. Empirical Results: Products and Markets

We now turn our attention to an extended analysis of changes in market shares across various regions and industries. To document further the nature of competition between Chinese exporters and exporters from other countries, we focus on bilateral competition in each of the markets in our sample using first data on the aggregate of trade in the 2,001 5-digit differentiated products used to develop Table 3.

Consider Figures 2-1 through 2-6. In these, we compare Chinese export share changes from 1995 to 2005 (measured on the horizontal axis) vs. the export market share changes for six possible export competitors (measured on the vertical axis) in the 73 remaining import markets in our sample.

Figure 2-1 plots market share changes from 1995 to 2005 for China and the United States in 73 importer markets. According to the figure the United States lost market share in all but eleven countries (most of these are African countries such as Tanzania), while China gained share in all 73 countries but Burundi. Figure 2-2 plots the market share changes for China and Japan. Similar to the United States, Japan lost market share in most countries in our sample, particularly in those in the Asian and Pacific regions.

[Insert Figures 2-1 and 2-2 about here]

Figures 2-3 and 2-4 provide the market share changes for Malaysia and Mexico, two of the countries which Hanson and Robertson considered as the potential competitors, each vis-à-vis China. Perhaps surprisingly, but consistent with the Hanson-Robertson conclusions, there are no clear market losses for Malaysia and Mexico relative to China during the period. Consider, for instance, the case of Malaysia. Most of the observations in the Figure 2-3 lie in the positive quadrant, suggesting that over this period exporters from the two countries may not compete strongly in at least these third country markets.[19] The data also suggest that Mexico and China do not compete strongly in third country markets. As Figure 2-4 shows, there is essentially no correlation between market share changes in the two countries. Indeed, Mexico's export shares in most markets hardly changed over the decade, even as China's shares rose across the board.

[Insert Figures 2-3 and 2-4 about here]

Finally in Figures 2-5 and 2-6 we diagram competition between China and two other countries, Germany and India. Consider first Figure 2-5. As the plot shows and as was the case with the United States and Japan, most of the observations are located in the lower quadrant of the diagram, suggesting that Germany also experienced market share losses in the face of Chinese competition. Figure 2-6 provides detail on the relationship between China and India in third markets. As the figure shows, the relationship between

[19] This is also consistent with the results reported in Aherne et al (2003).

Indian and Chinese market share changes over the decade from 1995 to 2005 is very similar to that between Mexico and China. Again there is little or no evidence of close competition between the exports of these countries in third country markets.

[Insert Figures 2-5 and 2-6 about here]

We turn now to focus on the major industrial sectors involved in the export market share changes detailed above. Again, using data from our seventy five country sample, Table 4 provides further detail on market share changes for China, Japan, and the United States by region and industry. In each of these regions for both SITC 1-digit industries 7 (machinery and transport equipment) and 8 (miscellaneous manufactures), Chinese export shares rose significantly, with gains exceeding 10 percentage points in most markets. And, as the table shows, regardless of region and product Chinese market share gains came at the expense of other developed countries. In many cases, the largest losses again were experienced by Japan and the United States.

[Insert Table 4 here]

6. Further Empirics: Exports by Industry

6.1 Unit Values of Chinese Export Goods

We have shown that China has increased its share of world exports, and, in particular, that the rise of China corresponds to market share losses by Japan and the United States. Although we have documented the picture of the share change from 1995 to 2005, we have not answered perhaps the most important question: is it possible to identify which factor (or factors) has (have) been most important in contributing to Chinese export growth? Such things may include an expansion of Chinese firms choosing to export, a growing advantage in export prices, and an upgrade in the quality of Chinese exports.

To explore this question, we first construct import unit values. We use essentially the same 5-digit SITC differentiated products involved in our construction of Table 3. We obtain the unit import values, by dividing import value for each product (*i*) traded from country *k* to *l* by corresponding quantity (weight). The data include imports of 75 importer countries from 74 trading partners for 1,724 products (5-digit SITC Rev.3) for year 1995 and 1,811 products for year 2005.[20] Before examining the unit prices globally, we summarize our findings on the behavior of the prices of Chinese and Japanese products over the decade relative to those charged by U.S. exporters in Figure 3. To do so, we take the simple average values of the import prices from China, Japan, and the United States across all the importing countries in our data set. Chinese and Japanese average prices are divided by corresponding prices from the United States, and then we take the logarithms of the relative prices. Figure 3 is constructed as follows. The logs of the relative prices for products, i=1, 2,…, I, for country k (k = China or Japan) in year t are organized in ascending order. Second, we assign the cumulative frequency $1/I$ to the product with the lowest relative price, $2/I$ to the product with the second lowest relative price, and I/I=1 to the product with the highest relative price. Then, Chinese and Japanese empirical cumulative distribution functions (cdf) across the 1,724 differentiated products are plotted for year 1995 and those across the 1,811 differentiated products are plotted for year 2005. In both years of 1995 and 2005, more than 85 percent of Chinese products are cheaper than corresponding U.S. products. In contrast, the majority of

[20] We choose the 1,724 (1,811) products for year 1995 (2005) from 2,001 total differentiated products since these products have observations from each of China, Japan, or the United States.

Japanese exports are expensive relative to U.S. products; this relationship remains stable across the two years in the sample. If a higher unit price from one country versus another denotes superior quality (Hallak, 2006, 2010), the surge in China's exports does not depend on an increase product quality at least over the time period of our study, since there is no significant change in the distribution of relative unit prices.

[Insert Figure 3 about here]

Our 5-digit level unit values vary not only because of differences in underlying shipping prices but also because of transportation costs. In order to get a better picture of the former, we use the unit value data to extract empirical proxies for f.o.b. import unit values ($p^{kl}{}_{it}$) of each differentiated product for each year 1995 or 2005 across 75 importers and 75 exporters. In particular, we assume that the measured import price of each product i shipped from country k to l (p_i^{kl}) depends on several variables: the export price of country k (p_i^k), the distance from country k to l (D^{kl}) which captures transport costs, and other control variables for any exporter-importer pairs such as dummy variables for regional trade agreements (FTA_t^{kl}), membership of WTO (WTO_t^{kl}), common language ($Language^{kl}$), and common border ($Border^{kl}$).[21] Finally, we capture exporter free on board (i.e., f.o.b values) prices, averaged across importing countries for each year, from exporter fixed effects (δ_{it}^{k}). We set an exporter fixed effect term for the United States to zero. Thus, the remaining exporter fixed-effects estimates for each of the two years represent export prices relative to the United States.

Based on the discussion above, our empirical model for import prices is given as:

[21] We create the dummy variables for FTA and WTO using information taken from the World Trade Organization Regional Trade Agreements Information System (RTA-IS). The dummy variables for common border and common language as well as bilateral distance between capital cities are obtained from the CEPII database.

$$(14) \quad \ln(p_{it}^{kl}) = \delta_{it}^{k} + \delta_{i1}\ln(D^{kl}) + \delta_{i2}FTA_{t}^{kl} + \delta_{i3}WTO_{t}^{kl} + \delta_{i4}Language^{kl} + \delta_{i5}Border^{kl} + \varepsilon_{it}^{kl}$$

Given the large number of estimates we have for each product, we do not report all the results. Instead, in Table 5, we provide summary statistics for the estimated coefficients, the proportion of coefficients that have the expected sign, and the proportion of those that are significant at the 5% level. Consider the table. Import prices are positively related to the log of distance between countries *k* and *l*. 97.7 (97.9) percent of product-level estimates have positive signs, 94.3 (93.6) percent of them for year 1995 (2005) are statistically significant. On average, a 1% increase in distance causes a 0.24% (0.20%) increase in import price. The FTA dummy variable is expected to be negative since countries that share an FTA agreement would reduce or eliminate commercial trade barriers. However, most of the signs on FTA dummy variable are insignificant.

[Insert Table 5 about here]

In addition, we report exporter fixed-effect coefficients for China and Japan ($\hat{\delta}_{it}^{k}$) for the years 1995 and 2005. Using 1995 data, more than 70 percent of the Chinese exporter fixed effect estimates are negative, and 41 percent are statistically significant. Using 2005 data, these proportions rise to 95.9 and 80.3 percent respectively. These estimates reinforce the evidence presented in Figure 3; compared to U.S. exports, Chinese products are cheaper across most products in markets throughout the world. One explanation for these price differentials is that Chinese exports may be of lower quality. Schott (2004) provides evidence that countries are vertically specialized in quality even within the same product. While developed countries export relatively high-quality high-value varieties, developing countries export low-quality low-price varieties. Although within-product specialization is a plausible story, these price differences may be due to any of a variety of other factors. First, although in the same 5-digit category, the two sets of products may be fundamentally different. Second, even though they may be the same type and have the same quality, Chinese products might simply be cheaper due to lower production costs (e.g. unit labor costs).[22]

To contrast the price advantage of Chinese products relative to other countries, we also study the coefficients on Japan relative to the United States. Only a small fraction of the Japanese exporter coefficients were negative, and few of these estimates were significantly different from zero. Thus, to the extent that Japanese products successfully compete against U.S. products in third markets appears to be due to factors other than price. On the other hand, these exporter coefficients point to price playing perhaps an even larger role in China's competitive edge vis à vis Japan than it does against the United States.

6.2 *Export Growth at the Intensive Margin*

In the discussions above and consistent with the findings of Amiti and Freund, we have shown that much of Chinese export growth in the past decade or so has been at the intensive margin. That is, over time an increasing number of Chinese firms in a particular industry have chosen to enter the export market. In this section we provide a model of this decision as well as empirical estimates based on the model.

The approach we take is based on a model developed by Helpman, Melitz, and Rubinstein (2008) (hereafter HMR). Demand in each country l is obtained from a two-tier utility function of a representative consumer. The upper tier of this function is separable into sub-utilities defined for each product i = 1, …, I: $U^l = U[u_1^l, ..., u_i^l, ..., u_I^l]$.

[22] We explore this possibility in the next sub-section.

The representative consumer uses a two-stage budgeting process. The first stage involves the allocation of expenditure across products. In the second stage, we derive the demand for each variety ω in product i from the utility maximization problem subject to the optimal expenditure (Y_{it}^{l}) obtained from the first stage.

The sub-utility index u_i^l is a standard CES (Constant Elasticity of Substitution) utility function: $u_i^l = \left[\int_{\omega \in B_{it}^l} [q_{it}^l(\omega)]^{\alpha_i} \, d\omega \right]^{1/\alpha_i}$. Here, $q_{it}^{l}(\omega)$ is country l's consumption of variety ω in product i in time t, B_{it}^{l} is the set of varieties in product i available for country l at t, and the time-invariant product-specific parameter α_i determines the elasticity of substitution across varieties so that $\varepsilon_i = 1/(1-\alpha_i) > 1$. From the utility maximization problem of a representative consumer, we can find the demand function for each variety:

$$(15) \qquad q_{it}^l(\omega) = \frac{[p_{it}^l(\omega)]^{-\varepsilon_i} Y_{it}^l}{(P_{it}^l)^{1-\varepsilon_i}} \text{ where } P_{it}^l = \left[\int_{\omega \in B_{it}^l} [p_{it}^l(\omega)]^{1-\varepsilon_i} \, d\omega \right]^{1/(1-\varepsilon_i)}$$

A firm in country k produces one unit of output with a cost minimizing combination of inputs that costs c_{it}^{k}, which is country, industry, and time specific cost for unit production. $1/a_{it}^{k}$ is firm-specific productivity measure (i.e., a firm with a lower value of a_{it}^{k} is more productive and that with a higher value of a_{it}^{k} is less productive) whose product-specific cumulative distribution function $G_i(a_{it}^{k})$ does not change over the period and has a time- and country-specific support $[\underline{a}_{it}^k, \bar{a}_{it}^k]$.

We assume that each variety ω is produced by a firm with productivity a_{it}^{k}. If this producer sells in its own market, it incurs no transportation cost. If this producer seeks to sell the same product in country l, it has to bear two additional costs: one is a fixed cost of serving country l (f_{it}^{kl}) and the other is an iceberg transport cost (τ_t^{kl}).

Since the market is characterized by monopolistic competition, a producer in country k with a productivity measure of a_{it}^{k} maximizes profits by charging the standard mark-up price: $p_{it}^{k}(a_{it}^{k}) = c_{it}^{k}a_{it}^{k}/\alpha_i$. If the producer in country k produces a variety in product i and exports to consumers in country l, the delivery price of the product is

(16) $$p_{it}^{kl}(a_{it}^{k}) = \frac{\tau_{it}^{kl}c_{it}^{k}a_{it}^{k}}{\alpha_i} \ .$$

As a result, the associated operating profits from the sales to country l are

(17) $$\pi_{it}^{kl}(a_{it}^{k}) = (1-\alpha_i)\left(\frac{\tau_{it}^{kl}c_{it}^{k}a_{it}^{k}}{\alpha_i P_{it}^{l}}\right)^{1-\varepsilon_i} Y_{it}^{l} - f_{it}^{kl}$$

Since the profits are positive in the domestic market for surviving firms (Melitz, 2003), all N_{it}^{k} producers are profitable in home country k. However, sales to an export market such as country l are positive when a firm is productive enough to cover both fixed and variable costs for exporting. Therefore, we define the cut-off productivity level $\underline{a}_{it}^{kl}$ by setting $\pi_{it}^{kl}(\underline{a}_{it}^{kl}) = 0$:

(18) $$(1-\alpha_i)\left(\frac{\tau_{it}^{kl}c_{it}^{k}\underline{a}_{it}^{kl}}{\alpha_i P_{it}^{l}}\right)^{1-\varepsilon_i} Y_{it}^{l} = f_{it}^{kl} \ .$$

The set B_{it}^{l} of varieties in product i available in country l is smaller than the total number of varieties produced in the world. In addition, $G_i(\underline{a}_{it}^{kl})$ could be zero since no firm from country k may find it profitable to export to country l at time t.

Equation (18) provides several possible explanations for China's success in the world market. First, competitive advances, perhaps through acquisition of foreign technology could lower the value of a_{it}^{k} as well as the variable cost of production and motivate Chinese firms to enter into foreign markets. Second, a decline in fixed costs of exporting and/or transport costs would also cause the cut-off productivity level to decline, thus generating an increase in the number of firms entering into the export market. On the demand side, an increase in Y_{it}^{l} would raise the profitability of exporting across the board, inducing more of less-productive firms to export.

Next, let

$$V_{it}^{kl} = \begin{cases} \int_{\underline{a}_{it}^{k}}^{\underline{a}_{it}^{kl}} (a_{it}^{k})^{1-\varepsilon_i}\, dG_i(a_{it}^{k}) & for \quad \underline{a}_{it}^{kl} \geq \underline{a}_{it}^{k} \\ 0 & otherwise \end{cases} \tag{19}$$

The demand function (15) and the pricing equation (16) then imply that the demand in country *l* for product *i* from country *k* in year *t* is given by:

$$m_{it}^{kl} = \left(\frac{c_{it}^{k} \tau_{it}^{kl}}{\alpha_i P_{it}^{l}} \right)^{1-\varepsilon_i} Y_{it}^{l} N_{it}^{k} V_{it}^{kl} \quad \text{where } (P_{it}^{l})^{1-\varepsilon_i} = \sum\nolimits_k \left(c_{it}^{k} \tau_{it}^{kl} / \alpha_i \right)^{1-\varepsilon_i} N_{it}^{k} V_{it}^{kl} \tag{20}$$

Note that the volume of bilateral imports (m_{it}^{kl}) equals zero when $\underline{a}_{it}^{kl} < \underline{a}_{it}^{k}$ because $V_{it}^{kl} = 0$.

We follow HMR and assume that firm productivity, $1/a_{it}^{k}$, is Pareto distributed. Thus in equation (19): $G_i(a_{it}^{k}) = [(a_{it}^{k})^{\kappa_i} - (\underline{a}_{it}^{k})^{\kappa_i}] / [(\overline{a}_{it}^{k})^{\kappa_i} - (\underline{a}_{it}^{k})^{\kappa_i}]$ where $\kappa_i > \varepsilon_i - 1$ and κ_i captures the shape of the distribution. The shape of the distribution is identical for each product across countries but, as we defined, the supports are different for countries for each year to capture technological progress from the productivity of the most productive firm in country *k* ($\underline{a}_{it}^{k}$). Then, we can further simplify V_{it}^{kl} as follows.

$$V_{it}^{kl} = \frac{\kappa_i [\underline{a}_{it}^{k}]^{\kappa_i - \varepsilon_i + 1}}{(\kappa_i - \varepsilon_i + 1)[(\overline{a}_{it}^{k})^{\kappa_i} - (\underline{a}_{it}^{k})^{\kappa_i}]} W_{it}^{kl} \quad \text{where } W_{it}^{kl} = \max\left\{ (\underline{a}_{it}^{kl} / \underline{a}_{it}^{k})^{\kappa_i - \varepsilon_i + 1} - 1, 0 \right\}. \tag{21}$$

The selection of firms into export markets is summarized in W_{it}^{kl}, which is determined by the cut-off value of $\underline{a}_{it}^{kl}$. This cut-off value is determined by the zero profit condition given by equation (18). Let us pick the most productive firm in country *k* in product*i* at year *t* and define the latent variable Z_{it}^{kl} as

(22) $$Z_{it}^{kl} = \frac{(1-\alpha_i)(P_{it}^l \alpha_i / c_{it}^k \tau_{it}^{kl})^{\varepsilon_i - 1} Y_{it}^l (\underline{a}_{it}^k)^{1-\varepsilon_i}}{f_{it}^{kl}}.$$

This is the ratio of variable export profits for the most productive firm to the fixed export cost for exporting from *k* to *l*. Positive exports are observed if and only if $Z_{it}^{kl}>1$. In addition, W_{it}^{kl} is a monotonic function of Z_{it}^{kl}; $W_{it}^{kl} = (Z_{it}^{kl})^{(\kappa_i - \varepsilon_i + 1)/(\varepsilon_i - 1)} - 1$.

Let $f_{it}^{kl} = \exp(\varphi_{it}^l + \varphi_{it}^k + \lambda_{it}\varphi_{it}^{kl} - e_{it}^{kl})$ where e_{it}^{kl} is random variable, φ_{it}^{l} is a fixed trade barrier for product *i* imposed by the importing country on all exporters in year *t*, φ_{it}^{k} is a measure of fixed export costs common across all export destinations, φ_{it}^{kl} is an observed measure of any additional country pair specific fixed trade costs. Using this specification together with $(\varepsilon_i - 1)\ln(\tau_{it}^{kl}) = \gamma_{it} d^{kl} - u_{it}^{kl}$ where d^{kl} is the log of distance between countries *k* and *l* and u_{it}^{kl} is a random error, the latent variable $z_{it}^{kl} = \ln(Z_{it}^{kl})$ can be expressed as

(23) $$z_{it}^{kl} = \beta_{it} + \beta_{it}^k + \beta_{it}^l - \gamma_{it} d^{kl} - \lambda_{it}\varphi_t^{kl} + \eta_{it}^{kl}$$

where $\eta_{it}^{kl}=u_{it}^{kl}-e_{it}^{kl}$ is random error; β_{it}^{k} is an exporter fixed effect that captures $(1-\varepsilon_i)\ln(c_{it}^{k})$, $(1-\varepsilon_i)\ln(\underline{a}_{it}^{k})$, and φ_{it}^{k}; β_{it}^{l} is an importer fixed effect that captures $(\varepsilon_i - 1)\ln(P_{it}^{l})\ln(Y_{it}^{l})$, and φ_{it}^{l}; and the remaining variables in equation (22) are constant for product *i* for year *t* (β_{it}).

Now, define the indicator variable T_{it}^{kl} to be 1 when country *k* exports product *i* to country *l* in year *t* and 0 when it does not. Let ρ_{it}^{kl} be the probability that product *i* of country *k* exports to country *l* conditional on the observed variables. We can specify the following Probit equation:

$$\begin{aligned} \rho_{it}^{kl} &= \Pr(T_{it}^{kl} = 1 \mid \beta_{it}, \beta_{it}^{k}, \beta_{it}^{l}, d^{kl}, \varphi_t^{kl}) \\ &= \Phi(\beta_{it} + \beta_{it}^{k} + \beta_{it}^{l} - \gamma_{it} d^{kl} - \lambda_{it}\varphi_t^{kl} + \eta_{it}^{kl}) \end{aligned} \tag{24}$$

where Φ is the cdf of the unit-normal distribution. Let $\hat{\rho}_{it}^{kl}$ be the predicted probability of exports of product *i* from country *k* to *l* in year *t*, and let $\hat{z}_{it}^{kl} = \Phi^{-1}(\hat{\rho}_{it}^{kl})$ be the predicted value of the latent variable. Then, an estimate for W_{it}^{kl} is obtained from

$$W_{it}^{kl} = \max\left\{(Z_{it}^{kl})^{(\kappa_i - \varepsilon_i + 1)/(\varepsilon_i - 1)} - 1, 0\right\}. \tag{25}$$

To estimate equation (24) for each product for each year (1995 or 2005), we employ data on bilateral trade across 81 countries (6,480 country pairs) for 144 3-digit differentiated products.[23] We prepare the following bilateral indexes for the estimation of equation (24): dummy variables for regional trade agreements (FTA_t^{kl}), common language ($Language^{kl}$), common border ($Border^{kl}$), and colonial ties ($Colony^{kl}$).[24] The dummy variables for the degree of bilateral legal strength ($Legal^{kl}$), business start-up costs ($Startup^{kl}$), and new business registration costs ($Register^{kl}$) are developed from the

[23] We use trade measured at the 3-digit level due to the enormous number of zero trade observations at further levels of disaggregation. See footnote 7 for the 81 countries in our sample. Since some countries do not report 3-digit level import data for years 1995 and 2000, we use data from the closest available years. This includes: Brunei 1997; Fiji 2000; Sri Lanka 1999; Benin 1998; Gabon 1996; Ghana 1996; Guinea-Bissau 2003; Mali 1996; Nigeria 1996; Senegal 1996; UAE 1996. For year 2005, we use 2003 data for Brunei and 2006 for Nigeria.

[24] We create the FTA variable using information taken from the World Trade Organization Regional Trade Agreements Information System (RTA-IS). The dummy variables for distance, common border, common language and colonial relationship are obtained from the CEPII website.

World Bank Development Indicators.[25] In the data the higher the value of the legal rights index indicates a stronger legal system in that country. We set $Legal^{kl}$ equal to one if the sum of the legal rights indices of the two countries is greater than the sample median. We set $Startup^{kl}$ equal to one if the sum of the business start-up costs in the two countries is greater than the median value. Finally, $Register^{kl}$ is one if the sum of the number of procedures required to register a new business in the two countries is less than the median value.

We report the estimation results of equation (24) for each of the 144 differentiated products in Table 6. For each product, we have at most 6,480 observations. The median value of observations is 5,920, of which 3,881 are zeros in year 1995. Although we have 6,480 observations for each product, we have to drop the observations if a country exports to all 80 trading partners, imports from all 80 countries, or does not export or import the product at all. For example, Japan exports passenger vehicles to all 80 countries in both years 1995 and 2005. In this case, we cannot estimate the probability of exports for Japanese auto industry since the observed probability is 100%. Given the large number of estimates we have for each product, we do not report all the results. Instead, in the table we provide summary statistics for the estimated coefficients, the proportion of coefficients that have the expected sign, and the proportion of those that are significant at the 5% level.

[Insert Table 6 about here]

Consider the table. The probability of successful exports from country k to l (ρ_{it}^{kl}) is negatively related to the log of distance between them. 100 percent of industry-level

[25] The World Bank Development Indicators data set does not include information on any of these three series for 1995. Consequently, in our empirical work we use 2005 data for both years.

estimates have negative signs and are statistically significant for both 1995 and 2005. Estimated coefficients on FTA dummy variables are expected to be positive since countries involved in an FTA share lower trade barriers. As expected, most of the signs are positive: 76.4 percent for year 1995 and 85.0 percent for year 2005; however, more than half of them are statistically insignificant at the 5% level. Interestingly, some business-related variables provide strong support for the model. The probabilities of positive trade among the country pairs with relatively strong legal systems ($Legal^{kl}$) and those with fewer procedures to register new businesses ($Register^{kl}$) are higher. Finally, for each year more than 60 percent of the coefficients on our proxy for the cost of business start ups ($Startup^{kl}$) carry the expected negative sign, most of them are statistically insignificant.

As we did for our estimates of export prices, we report exporter-specific coefficients for China and Japan ($\hat{\beta}_{it}^{k}$) for years 1995 and 2005. As before, we set the exporter-specific fixed effect variable for the United States to zero for each product and year. Thus, the reported values in Table 6 for China and Japan are relative to the United States. Using 1995 data, China's probabilities of successful exports are lower than the United States for 82.9 percent of the 140 products in the sample, and 53.6 percent are statistically significant at the 5% level. This pattern reversed over the period we consider. Using 2005 data, China's probabilities of exporting are higher than the United States for 78.6 percent of the 140 products; 49.3 percent of them are statistically significant at the 5% level. Finally, in contrast to the case of China, there is virtually no change in the sign pattern for Japanese exporter fixed effects over the period: 72.9 percent in 1995 and 73.6 percent in 2005 carry negative signs.

We can use the estimated coefficients from our model to illustrate how the probabilities of successful exports of various product types by exporters in various countries have changed over time. As an example we consider two products, *Sound Recorders* (SITC 96) and *Footwear* (SITC 126). We construct the predicted probability of exports (the values of $\hat{\rho}_{it}^{kl}$ from equation (24)) from China, Japan, and the Philippines to each of the 80 trading partners for years 1995 and 2005.[26] Figure 4-1 provides the case of *Sound Recorders*. While Japanese probabilities of exporting were uniformly higher in 1995 (Japanese probabilities first-order dominate Chinese ones), that situation had reversed by 2005. Figure 4-2 shows the results for *Footwear*. While the Philippine probabilities did not change much over time, Chinese probabilities shifted out, indicating that Chinese export probabilities had increased all over the world.

According to our theoretical model, more firms will choose to enter an export market over time if they are increasingly able to achieve a necessary productivity cut-off level. As we discussed above, this could be due to any of a number of factors including rising standards of living throughout the world, technological advances in transportation technology, or country specific advances in production technology at the industry level. While our empirical model does not allow us to identify which of these factors may be paramount in explaining export success, it is possible to use it to estimate the product level cutoff productivity levels necessary to insure participation in a particular export

[26] The choice of Japan and the Philippines for this example is due to the geographical issues. Since the results in Table 6 imply that distance is a significant indicator of export success, we chose countries geographically close to China to try to control for this effect.

market.[27] Remember that $\hat{\rho}_{it}^{kl}$ is the predicted probability of exports of product *i* from country *k* to *l* in year *t*, using the estimates from (24). Let $\hat{z}_{it}^{kl} = \Phi^{-1}(\hat{\rho}_{it}^{kl})$ be the predicted value of the latent variable. Then, an estimate for W_{it}^{kl} is obtained from $W_{it}^{kl} = (Z_{it}^{kl})^{(\kappa_i - \varepsilon_i + 1)/(\varepsilon_i - 1)} - 1$ for non-zero observations. Assuming that κ^i and ε^i are constant over time, we can use equation (21) to show the relationship between our estimates of the latent variable and the cut-off point of productivity for each product :

(26) $$\hat{z}_{it}^{kl} = (\varepsilon_i - 1)\ln(\hat{\underline{a}}_{it}^{kl} / \hat{\underline{a}}_{it}^{k})$$

where we have at most 11,200 observations (140 products for 80 importer countries) for each exporting country *k* for each year 1995 or 2005.

Figures 5-1 through 5-3 provide scatter plots of the cut-off relative productivity of product *i* for importing country *l* (equation (26)) for year 1995 against that for year 2005 for three exporting countries: the United States, Japan, and China, respectively. We have 11,131 cut-off productivities for the United States, 11,030 for Japan, and 11,110 for China. Interestingly, there are no significant changes over the period we consider for the United States and Japan. In each case the plots are distributed along the 45° line. According to our model, this suggests that the number of firms in these two countries choosing to export remained essentially constant between 1995 and 2005. This is because there was no change of the cut-off points of productivities to entry into export markets, i.e. the $\underline{a}_{it}^{kl}$ relative to the productivity levels of the most efficient firms ($\underline{a}_{it}^{k}$). Coupled with our findings on export price patterns, our results indicate relatively static conditions for American and Japanese exports.

[27] Note, however, that given the across the board growth of Chinese exports relative to the exports of other countries, demand conditions and transport cost technology (which would have impacted all potential entrants) probably were not as important as technological innovations in China.

[Insert Figures 5-1 to 5-3 about here]

In contrast, it is interesting to observe an across the board shift in productivity cut-off points for Chinese exporters. In virtually all cases the observations in Figure 5-3 lie above the 45^o line. Since the cut-off points relative to the most productive firm's productivity have declined, our model suggests that the number of Chinese firms with the capacity to successfully export to foreign markets has increased dramatically and these increases have been across virtually all products and in virtually all markets in our sample.

7. Conclusions

The growth of Chinese exports both in volume and in market share over the past two decades is a singular event in the history of world trade. Using data from 1995-2005, we document this growth in a variety of ways. First, we show that the expanded trade is pervasive. Virtually every country in the world has seen China claim a larger share of its import market. Then, we use CMS analysis to try to determine which country or countries have lost market share as China's trade has grown. Contrary to much discussion in the popular press, we find strong evidence that other developing countries have not seen export shares fall as a result of China's gains. Rather, our results suggest that China's share growth has come largely at the expense of exporters based in Japan and the United States. In this paper, we cannot identify the central reason why these two countries lost market shares to China. We do find strong evidence of productivity advances across virtually all industrial sectors in China. This suggests a strong impetus for more Chinese firms to enter the export market.

References

Ahearne, Alan G., John G. Fernald, Prakash Loungani, and John W. Schindler, 2003, "China and Emerging Asia: Comrades or Competitors?," *Federal Reserve Bank of Chicago Working Paper*, #27-2003.

Amiti, Mary and Caroline Freund, 2010, "An Anatomy of China's Export Growth," in Robert Feenstra and Shang-Jin Wei (eds.), *China's Growing Role in World Trade*, (Cambridge, Massachusetts: National Bureau of Economic Research).

Branstetter, Lee, and C. Fritz Foley, 2007, "Facts and Fallacies About U.S. FDI in China," *NBER Working Paper* #13470.

Broda, Christian and David E. Weinstein, 2006, "Globalization and the Gains from Variety" *Quarterly Journal of Economics*, pp. 541-585.

Cassing, James and Steven Husted, 2004, "Trade Pattern Persistence," in Michael Plummer (ed.), *Empirical Methods in International Trade: Essays in Honor of Mordechai Kreinin*, Edward Elgar, 2004, pp. 91-109.

_____, 2009, "Transient Products but Persistent Trade Patterns," *Journal of Economic Studies*, pp. 583-595.

Fagerberg, Jan and Gunnar Sollie, 1987, "The Method of Constant Market Shares Analysis Reconsidered," *Applied Economics*, pp. 1571-1583.

Hallak, Juan Carlos., 2006, "Product Quality and the Direction of Trade," *Journal of International Economics*, pp. 238-265.

_____, 2010, "A Product Quality View of the Linder Hypothesis," *Review of Economics and Statistics*, pp. 453-466.

Hanson, Gordon and Raymond Robertson, 2010, "China and the Manufacturing Exports of Other Developing Countries in Robert Feenstra and Shang-Jin Wei (eds.), *China's Growing Role in World Trade*, (Cambridge, Massachusetts: National Bureau of Economic Research).

Helpman, Elhanan, Marc J. Melitz, and Yona Rubinstein, 2008, "Estimating Trade Flows: Trading Partners and Trading Volumes," *Quarterly Journal of Economics*, pp. 441-487.

Irwin, Douglas, 1995, "The Lion's Share: Britain's Export Performance Revisited, 1899-1929," *Structural Change and Economic Dynamics*, pp. 97-109.

Leamer, Edward and Robert Stern, 1970, *Quantitative International Economics*, (Boston: Allyn and Bacon).

Manova, Kalina, 2010, “Credit Constraints, Heterogeneous Firms, and International Trade,” mimeo, Department of Economics, Stanford University.

_____ and Zhiwei Zhang, 2009, “China’s Exporters and Importers: Firms, Products and Trade Partners,” *NBER Working Paper*, #15249.

Melitz, Marc J., 2003, “The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity,” *Econometrica*, pp. 1695-1725.

Rauch, James E., 1999, “Networks versus Markets in International Trade,” *Journal of International Economics*, pp. 7-35.

Richardson, J. David, 1971, “Constant Market Shares Analysis of Export Growth,” *Journal of International Economics*, pp. 227-239.

Rodrik, Dani, 2006, “What’s So Special about China’s Exports?,” *NBER Working Paper* #11947.

Schott, Peter K., 2004, “Across-Product Versus Within-Product Specialization in International Trade,” *Quarterly Journal of Economics*, pp. 647-676.

Schott, Peter K., 2008, “The Relative Sophistication of Chinese Exports,” *Economic Policy*, pp. 5-49.

Tomiura, Eiichi, 2008, “Offshore Outsourcing by Japanese Firms,” Research Institute of Economy, Trade, and Industry, *Research & Review #2008/3*. On the web at: http://www.rieti.go.jp/en/papers/research-review/045.html.

Tables and Figures

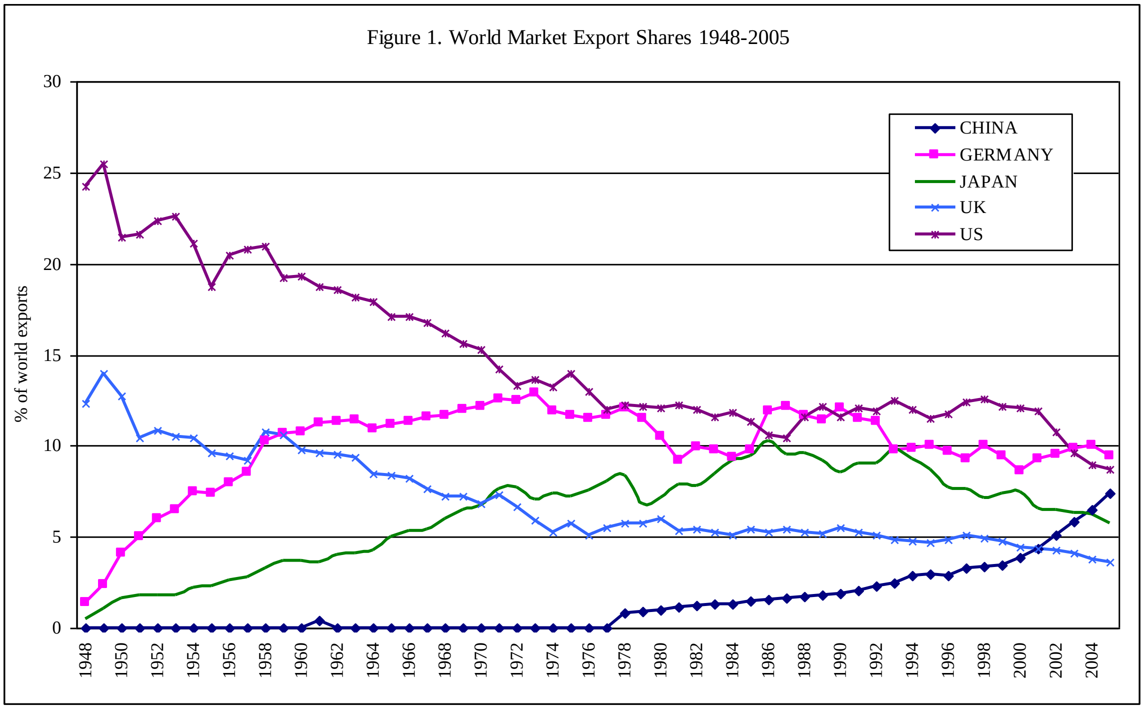

Table 1. China's National Export Market Share by Region

	Countries	2005 National Market Shares				Share Change 1995-2005			
		Average	Std. Dev.	Maximum	Minimum	Average	Std. Dev.	Maximum	Minimum
Africa	22	7.4	8.3	39.1	1.6	5.0	7.8	36.4	-1.0
Asia	16	12.8	9.8	45.0	3.2	6.5	3.2	10.6	0.4
Europe	17	4.1	1.8	8.8	1.2	2.6	1.6	7.4	0.3
Middle East	7	5.5	2.9	9.9	2.3	3.1	1.7	5.8	1.0
North America	3	8.4	6.2	13.0	2.7	5.4	3.4	8.7	2.0
South America	16	5.2	2.2	9.3	2.2	4.2	2.0	9.3	1.5
Total	81	7.2	7.0	45.0	1.2	4.5	4.6	36.4	-1.0

Table 2. Structure of Chinese Exports

SITC Rev 3	Commodities	I. Commodity Structure of Chinese Exports: All countries		I. Commodity Structure of Chinese Exports: Developing countries		II. China's shares in world exports (China's exports/World exports)	
		1995	2005	1995	2005	1995	2005
0	Food and live animals	6.6	3.0	5.4	2.2	3.2	4.8
1	Beverages and tobacco	0.8	0.1	1.6	0.3	2.3	1.6
2	Crude materials	2.9	1.0	2.1	0.5	2.6	3.5
3	Mineral fuels	3.6	2.1	2.3	2.4	1.6	1.2
4	Animal and vegetable oils	0.3	0.0	0.8	0.0	1.2	0.8
5	Chemicals and related products	6.0	4.5	6.3	5.5	2.0	3.6
6	Manufactured goods (materials)	21.2	16.0	26.9	18.1	5.0	11.1
7	Machinery and transport equipment	21.4	47.8	23.8	51.7	3.1	13.1
8	Miscellaneous manufactured articles	37.0	25.2	30.3	18.9	17.9	28.2
9	Other commodities	0.2	0.2	0.5	0.3	0.8	2.0

Notes: We use Chinese export data for panel I. We use 74 countries' imports from China and total for panel II.
Benin, Gabon, Ghana, Mali, Senegal, and Guyana are excluded in panel II for 1995.

Table 3. Export Market Share Change Decomposition: Selected Countries (1995-2005)

	Fagerberg and Sollie Decomposition (2,001 SITC 5-digit Products)					
	Market Share	Commodity Composition	Commodity Adaptation	Market Composition	Market Adaptation	Total Change in Share
Africa	0.045	-0.065	0.033	-0.017	0.001	-0.002
Ghana	-0.007	-0.007	0.006	0.000	0.000	-0.008
Kenya	0.000	0.000	0.000	0.000	0.000	0.000
Asia and Pacific	5.192	-2.167	2.246	0.680	0.465	6.417
Australia	0.029	0.045	-0.043	-0.014	-0.012	0.004
China	9.563	-0.659	0.657	-0.468	0.331	9.423
Indonesia	0.301	-0.062	-0.066	0.001	-0.058	0.117
Japan	-4.449	-0.709	0.246	0.826	-0.174	-4.259
South Korea	-0.247	-0.650	1.040	0.237	0.434	0.814
Malaysia	0.228	-0.113	0.139	-0.145	0.155	0.265
Philippines	0.278	0.087	0.209	-0.041	0.078	0.612
India	0.402	-0.040	0.000	-0.032	0.007	0.337
Thailand	0.288	0.032	-0.059	-0.076	0.031	0.217
Europe	-2.612	0.073	-0.554	-1.169	-0.204	-4.466
France	-0.660	-0.079	0.108	-0.089	-0.011	-0.732
Germany	-0.306	-0.473	-0.262	-0.185	-0.087	-1.312
Italy	-0.459	-0.467	-0.205	-0.094	-0.043	-1.269
Spain	0.283	-0.079	0.101	-0.077	-0.055	0.172
United Kingdom	-0.967	0.551	-0.468	-0.099	0.008	-0.975
Middle East	0.428	0.040	-0.065	0.004	0.004	0.412
North America	-3.689	1.684	-0.925	0.569	-0.282	-2.643
Canada	-0.344	0.306	-0.292	0.244	-0.058	-0.144
Mexico	0.527	0.046	0.112	0.122	0.026	0.834
USA	-3.871	1.331	-0.744	0.203	-0.250	-3.333
South America	0.337	-0.071	0.070	-0.068	0.015	0.282
Argentina	-0.001	-0.075	0.048	-0.037	0.011	-0.054
Brazil	0.198	0.013	0.034	-0.033	-0.018	0.194

Note: Fiji (2000-2005), Sri Lanka (1999-2005), Brunei (1997-2003), Guinea-Bissau (2003-2005), United Arab Emerirates (1999-2005), and Nigeria (1996-2006) are dropped from 81 countries.

Figure 2-1. Share Changes between China and USA in 3rd Markets

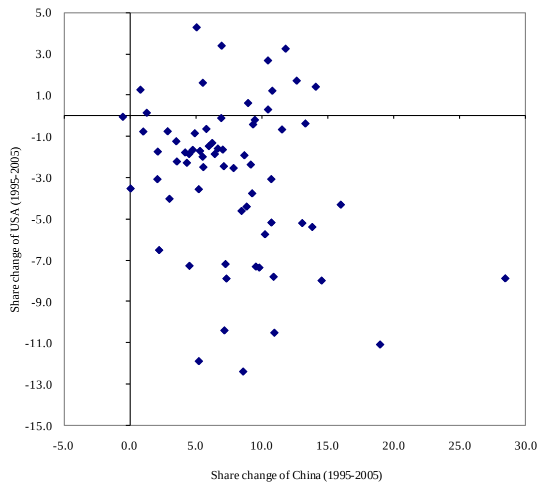

Figure 2-2. Share Changes between China and Japan in 3rd Markets

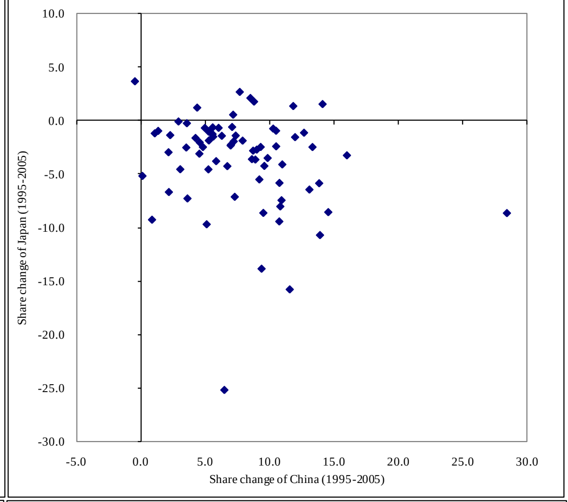

Figure 2-3. Share Changes between China and Malaysia in 3rd Markets

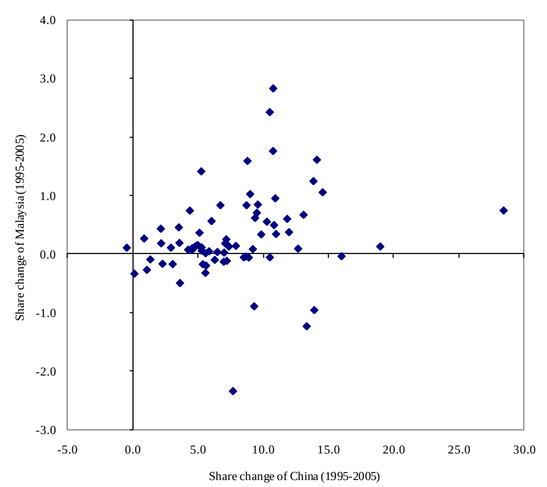

Figure 2-4. Share Changes between China and Mexico in 3rd Markets

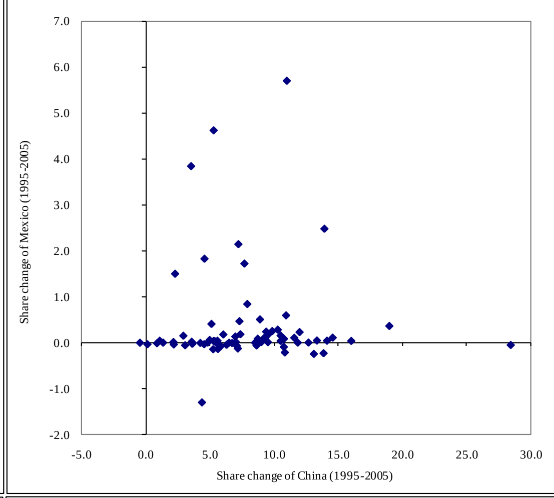

Figure 2-5. Share Changes between China and Germany in 3rd Markets

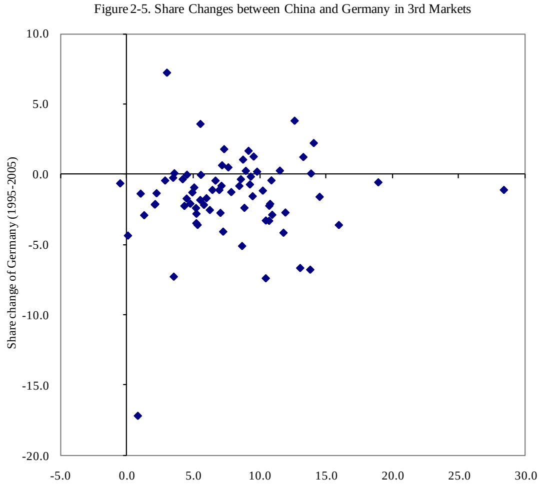

Figure 2-6. Share Changes between China and India in 3rd Markets

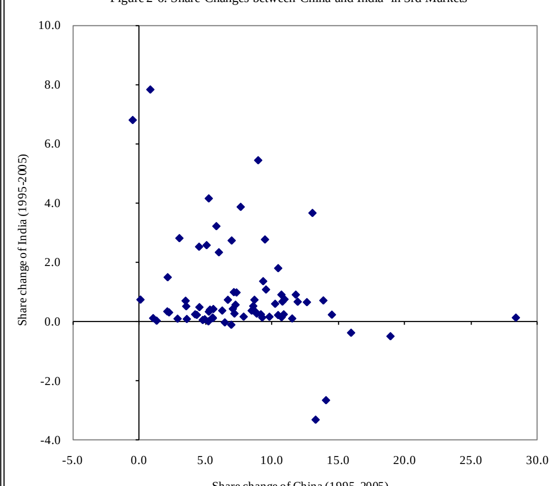

Table 4. Changes in Export Shares of China, Japan, and USA in Regional Markets (1995-2005)

	North America	Europe	Asia&Pacific	Others	Total
I. Machinery and transport equipment (SITC 3, Industry 7)					
China	12.5	6.9	16.0	7.2	11.4
Japan	-10.0	-3.4	-9.4	-1.5	-6.6
USA	-3.0	-3.0	-8.1	-8.3	-4.7
Developed (exclude Japan and USA)	-4.0	-3.1	-4.2	-1.3	-4.5
Developing (exclude China)	4.5	2.6	5.8	3.9	4.4
II. Miscellaneous manufactured articles (SITC 3, Industry 8)					
China	15.5	11.0	4.1	14.8	11.0
Japan	-3.8	-1.4	0.1	-2.0	-1.7
USA	-3.4	-1.2	-3.7	-8.7	-2.8
Developed (exclude Japan and USA)	-4.4	-7.0	1.1	-4.9	-5.0
Developing (exclude China)	-3.9	-1.5	-1.6	0.7	-1.5
III. Other industries (SITC 3, Industries 0-6, and 9)					
China	3.5	1.4	2.3	3.5	2.4
Japan	-2.4	-0.2	-1.6	-1.1	-1.1
USA	-3.5	-0.4	-7.5	-4.7	-2.9
Developed (exclude Japan and USA)	-1.1	-1.5	4.2	-5.2	-1.7
Developing (exclude China)	3.5	0.7	2.6	7.5	3.3

Note: The countries in each region correspond to Table 1.

Figure 3
Export Prices of Chinese and Japanese Goods Relative to U.S. Goods

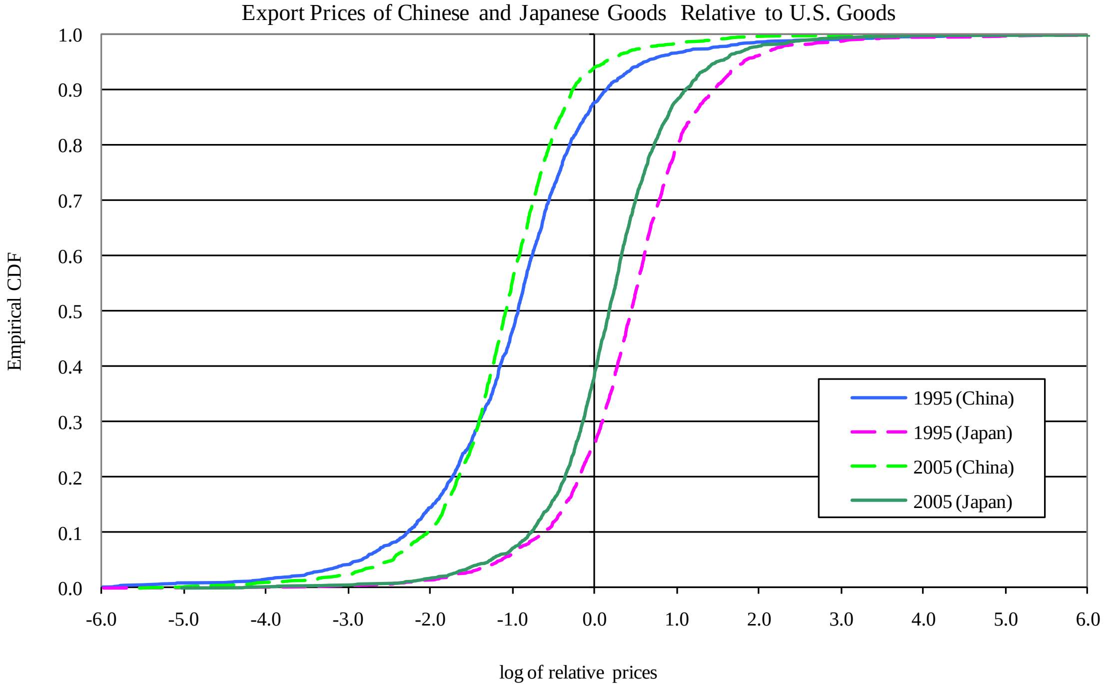

Table 5. Import Price Estimates

	Expected signs	Sign match (%)	Sign match & 5% significance	Median	Max	Min	St. Dev
Year: 1995							
Coefficients							
log($distance^{kl}$)	+	97.7	94.3	0.244	0.949	-0.158	0.124
FTA_t^{kl}	-	18.9	6.5	0.273	3.552	-1.985	0.402
WTO_t^{kl}	-	14.6	2.7	0.394	8.682	-2.977	0.550
$Border^{kl}$	-	34.7	9.2	0.093	2.884	-3.606	0.327
$Language^{kl}$	-	79.4	30.9	-0.141	0.649	-1.493	0.214
China Dummy	-	70.9	41.0	-0.450	5.515	-7.742	0.908
Japan Dummy	-	21.7	3.5	0.341	2.881	-2.229	0.494
Observations				469	1813	36	280
Adjusted R squares				0.190	0.612	-0.241	0.090
Year: 2005							
Coefficients							
log($distance^{kl}$)	+	97.9	93.6	0.201	0.889	-0.977	0.111
FTA_t^{kl}	-	12.3	1.6	0.204	2.629	-7.035	0.299
WTO_t^{kl}	-	11.9	2.4	0.670	11.089	-2.943	0.878
$Border^{kl}$	-	25.2	7.6	0.182	2.176	-2.690	0.350
$Language^{kl}$	-	78.3	33.1	-0.115	1.393	-2.877	0.215
China Dummy	-	95.9	80.3	-0.815	2.909	-4.781	0.543
Japan Dummy	-	28.1	5.0	0.230	2.533	-3.295	0.481
Observations				798	2898	16	502
Adjusted R squares				0.131	0.918	-0.271	0.084

Notes: (1) 1,720 products for year 1995 and 1,809 products for year 2005 are estimated from OLS with robust standard errors.
(2) Fiji, Sri Lanka, Brunei, Guinea-Bissau, UAE, and Nigeria are excluded from 81 countries.

Figure 4-1. Predicted Probability of Export (SITC 96: Sound Recorders)

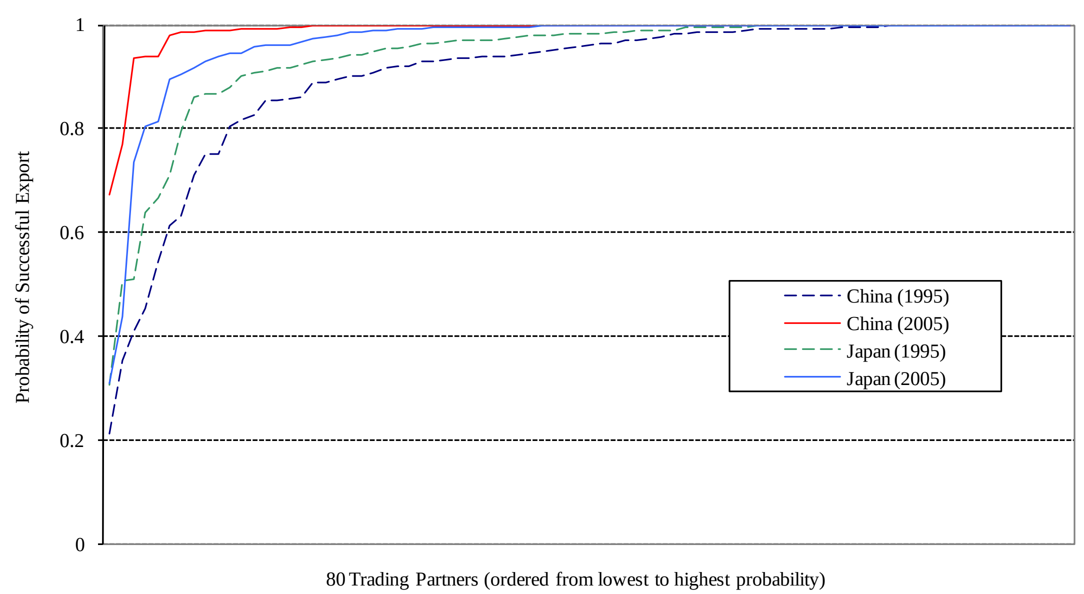

Figure 4-2. Predicted Probability of Export (SITC 126: Footwear)

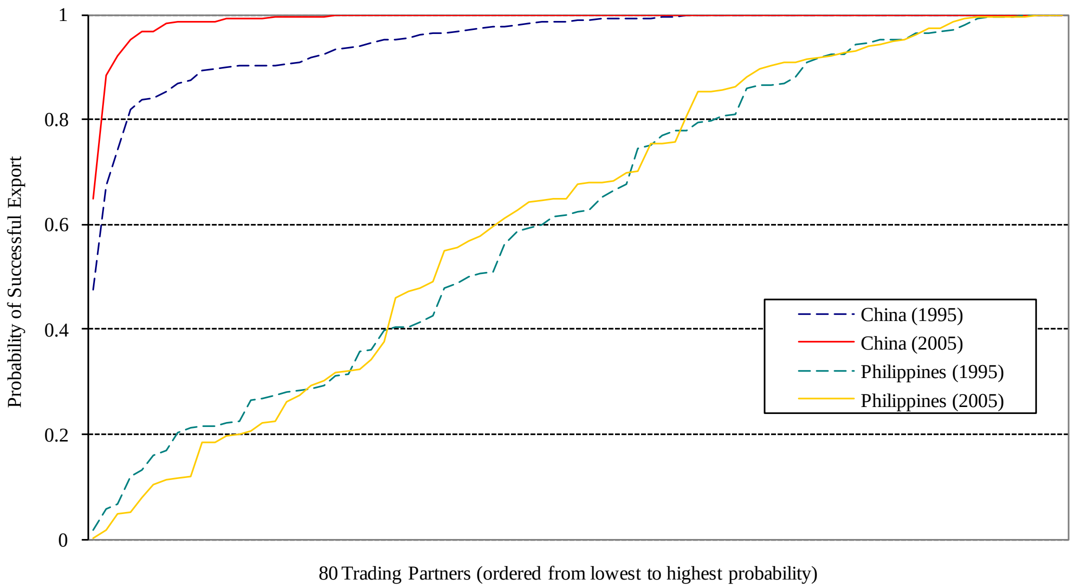

Figure 5-1 Ratio of the Most Efficient to Export Cut-off Productivities (USA)

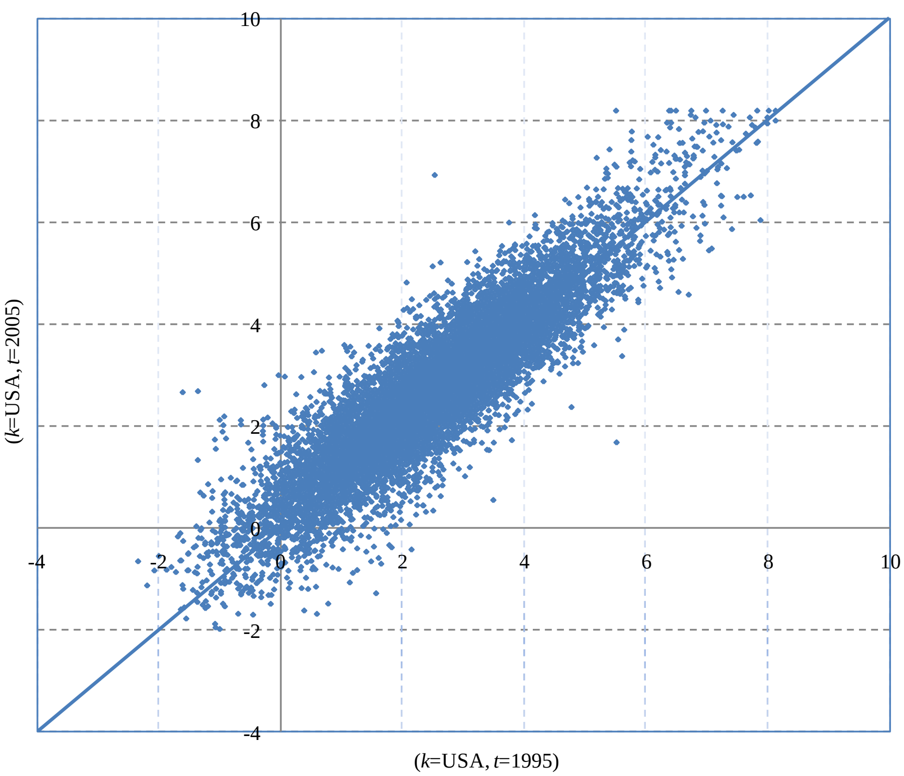

Figure 5-2 Ratio of the Most Efficient to Export Cut-off Productivities (Japan)

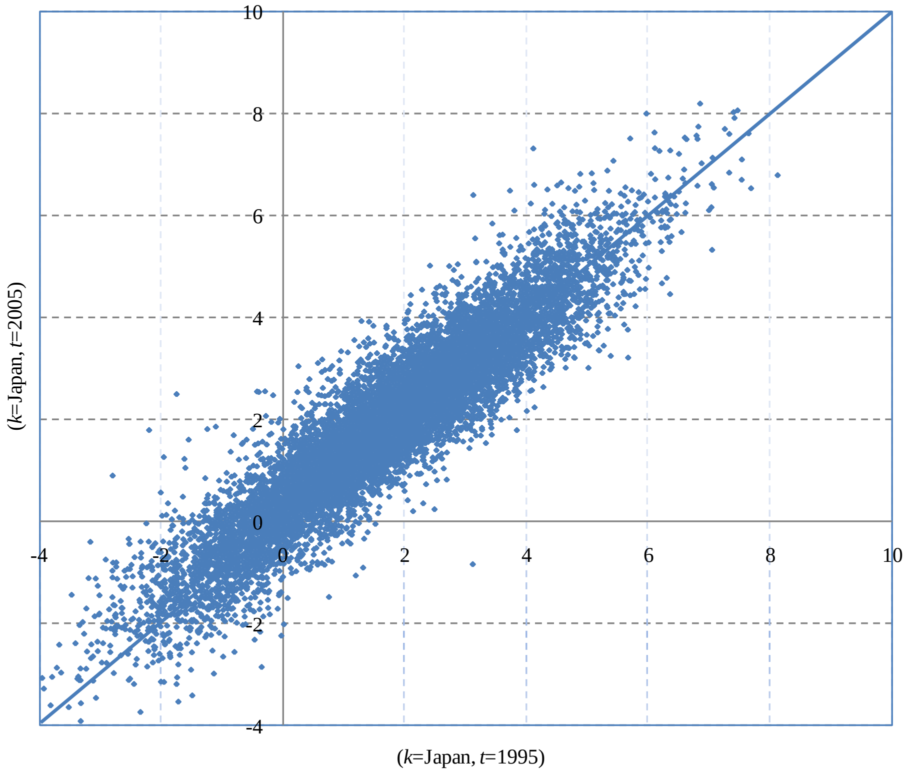

Figure 5-3 Ratio of the Most Efficient to Export Cut-off Productivities (China)